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***Review of the Acid  
Deposition  
Management  
Framework  
and Its  
Implementation***





**Review of the  
Acid Deposition Management Framework  
and Its Implementation**

by

Acid Deposition Assessment Group

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## FOREWORD

Alberta Environment adopted the Acid Deposition Management Framework developed by the Clean Air Strategic Alliance for management of acid deposition effects in Alberta. The framework was described in the report: *Application of Critical, Target, and Monitoring Loads for Evaluation and Management of Acid Deposition (AENV, 1999)*. The framework prescribes a 5-year assessment cycle involving:

- Assessment of potential acid input (PAI) in each 1° latitude by 1° longitude grid cell in Alberta using the REgional Lagrangian Acid Deposition (RELAD) model.
- Evaluation of RELAD model-based PAI estimates using monitoring data.
- Revision of receptor sensitivity, as appropriate, based on new data.
- Comparison of PAI to receptor sensitivity. Management actions for acidifying emissions are required if monitoring, target, or critical loads are exceeded.
- Review, and possible revision, of the framework.

The Acid Deposition Assessment Group (ADAG) was appointed by Alberta Environment to guide the assessment and review the framework. ADAG consists of representatives from government, industry, and environmental organizations. Three documents were produced:

- an acid deposition assessment report
- a framework review report, and
- an acid deposition management framework document.

This document is the framework review report that summarizes conclusions and recommendations arising from the review by the ADAG of the 2004 acid deposition assessment and of the 1999 framework.

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Chair, Acid Deposition Assessment Group  
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## 1.0 INTRODUCTION

The Acid Deposition Assessment Group (ADAG) was appointed by Alberta Environment (AENV) in 2002 to function as an advisory body to the implementation and review of the Acid Deposition Management Framework: *Application of Critical, Target, and Monitoring Loads for the Evaluation and Management of Acid Deposition* (AENV, 1999). This framework was developed by the Clean Air Strategic Alliance (CASA) and adopted by Alberta Environment in 1999 for the management of acid deposition effects in Alberta. The framework, referenced as 'the 1999 framework' in this document, prescribes a 5-year assessment cycle involving:

- ◆ Assessment of acid deposition, which entails:
  - Assessment of potential acid input (PAI) in each 1° latitude by 1° longitude grid cell in Alberta using the REgional Lagrangian Acid Deposition (RELAD) model. The initial assessment under the 1999 framework was completed in 1999 with a second assessment scheduled for approximately 2004.
  - Evaluation of RELAD model-based PAI estimates using monitoring data.
  - Revision of receptor sensitivity, as appropriate, based on new data.
  - Comparison of PAI to receptor sensitivity. Management actions for acidifying emissions are required if monitoring, target, or critical loads are exceeded.
  - Review, and possible revision, of the framework.

The ADAG consists of representatives from government, industry, and environmental organizations (Appendix 1).

This document summarizes conclusions and recommendations arising from the review by the ADAG of the 2004 acid deposition assessment and of the 1999 framework.

## 2.0 2004 ACID DEPOSITION ASSESSMENT

The ADAG has reviewed the 2004 acid deposition assessment and provides the following conclusions:

- ◆ *Potential Acid Input in 2004:* The results of the acid deposition assessment are reported in detail in the report "2004 Acid Deposition Assessment for Alberta", prepared for ADAG by WBK and Associates (2007a). The following are the key results of the assessment:
  - The year 1980 is a representative meteorological year for modeling purposes. The selection of 1980 was based on examination of RELAD model estimates for each of the years 1971 to 2000 using 1995 emission data and meteorological data for each of the years 1971-2000.
  - Sulphur emissions declined from 1995 to 2000 and are predicted to rise from 2000 to 2010, but not up to the 1995 level.
  - Nitrogen emissions increased from 1995 to 2000 and a further increase is predicted by 2010.
  - RELAD model-based deposition estimates were determined with 1980 meteorology and 1995 and 2000 emission inventories and 2010 emission projections. There were increases and decreases over time in PAI in individual grid cells, but no clear or consistent trend. PAI did not exceed monitoring, target, or critical levels in any grid cell for any of these three emission scenarios.
- ◆ *Model Evaluation:* Potential Acid Input estimated from wet deposition measurements and air quality data was in general agreement with RELAD model-based results. However, the evaluation of model results was not as clear-cut as ADAG had hoped it would be, possibly due to the following:
  - a. Emissions may vary substantially from year to year. The emission inventory used for modeling may differ from actual emissions during each of the years for which monitoring results were compared to model estimates.
  - b. Meteorology varies from year to year so the 1980 meteorology may differ from the actual meteorology in each of the years for which monitoring results were compared to model estimates.
  - c. RELAD estimates are for average PAI over a grid cell, while monitoring stations measure site specific air quality, which may differ from the grid cell average, depending on proximity of the monitoring station to significant emission sources.

◆ *Receptor Sensitivity:*

- a. A number of studies to advance understanding of soil sensitivity were conducted during the 1999-2004 assessment cycle, largely in the oil sands region. These studies do not yet provide a basis for altering the sensitivity ratings currently assigned to grid cells.
- b. A number of studies to advance understanding of lake sensitivity were conducted during the 1999-2004 assessment cycle, largely in the oil sands region. These studies suggest that subsoil sensitivity may not be a reliable surrogate for lake sensitivity. However, these studies do not yet provide a basis for altering the sensitivity currently assigned to grid cells.
- c. The acid deposition sensitivity of the Provost-Esther grid cell was reassessed, after finding in the 1999 acid deposition assessment that PAI was  $0.18 \text{ keq H}^+/\text{ha/yr}$ , which was in excess of the monitoring load of  $0.17 \text{ keq H}^+/\text{ha/yr}$  assigned to that cell. This grid cell and an adjacent grid cell were reclassified from highly to moderately sensitive, based on analysis and interpretation of soil samples in the grid cell (AENV, 2001).

- ◆ *Potential Acid Input in Relation to Management Thresholds:* using emission inventories for 1995 and 2000, or emission projections for 2010, PAI does not exceed the critical load, the target load, or the monitoring load in any grid cell. Consequently, acid deposition does not exceed any of the thresholds requiring management actions under the 1999 framework.

### 3.0 REVIEW OF THE 1999 MANAGEMENT FRAMEWORK

The ADAG has reviewed the 1999 management framework and provides the following conclusions:

- The 1999 framework was the first framework for the management of sulphur and/or nitrogen emissions in Alberta, aside from air quality standards. Since then other provincial and/or national management frameworks with implications for the management of sulphur and/or nitrogen emissions have been adopted (Appendix 2). One or more of these frameworks may potentially result in enhanced emission management actions even though the 1999 framework does not.
- The 1999 framework continues to provide a good basis for managing acid deposition on a provincial scale and no substantive changes are recommended.
- Enhancements to management of acid deposition on a local scale:

A key principle is that acid deposition on a local scale should be managed to provide a level of protection equivalent or better to that of the provincial framework. A key feature of local assessment of acid deposition is the use of a local/regional scale model (currently CALPUFF). This model provides a sufficient spatial resolution of deposition in the vicinity of large point sources or multiple closely spaced sources. It can also help to manage emissions and protect resources that may not be adequately protected by a 95% level of protection on a 1° latitude x 1° longitude grid cell. The ADAG has developed a new framework document (AENV, 2007b) that summarizes the 1999 approach to provincial assessment and includes recommended enhancements to the approach for local assessment.

- Consideration of a strategy to enhance the provincial receptor sensitivity database:
  - a. Soils: The 1999 framework defines three categories of sensitivity (low, medium, and high), based on soil properties in the vegetation rooting zone. Numeric monitoring, target, and critical loads were assigned to each of these three categories based on a review of studies in other jurisdictions. This continues to be the best approach with the soil data that is available on a provincial scale. The strategy should consider enhancing the soil database to support consideration of alternative approaches for setting grid-cell specific monitoring, target, and critical loads. The simple mass balance model has been widely used in Europe and eastern Canada for this purpose and dynamic models are being considered in Europe and being developed in the oil sands region.
  - b. Lakes: The strategy should also consider enhancing the lake sensitivity database to support consideration of alternative approaches for determination of lake-specific critical loads based on watershed characteristics. Various steady state and dynamic models are available for this purpose.

- Review of the treatment of nitrogen in the framework:

The approach adopted in the 1999 framework treats all deposited nitrogen as acidifying. This may over-estimate the acidifying effect of deposited nitrogen. Since target loads are not currently exceeded on any grid cell in Alberta, there has not been an urgent need to date to revise this approach. However, this may change with increasing population growth and industrial development in the province. The Cumulative Environmental Management Association (CEMA) has recommended, and AENV has accepted, an interim approach for environmental impact assessments in the oil sands region. Under this approach, any nitrogen deposition in excess of 10 kg/ha/yr, and 25% of the first 10 kg/ha/yr of deposited nitrogen, will be considered acidifying. A CASA nitrogen project team may be a suitable body to conduct a review of nitrogen related issues including acidification and eutrophication.

- The RELAD model is the model selected for estimating acid deposition in the Acid Deposition Management Framework. Our understanding of atmospheric chemistry, dispersion processes, and deposition mechanisms has improved but the RELAD model has not been upgraded to reflect our improved knowledge. There is a need to review deposition models to determine whether RELAD remains the most appropriate model to use or if it requires updating.
- The current assessment is for the five-year cycle period ending in 2004. Although the process was initiated in 2001, it took approximately five years to complete. The main reasons for the length of the review process were: the delayed release of the 2000 emission data, and the lack allocation of sufficient resources from Alberta Environment. Another minor reason was the time required for developing a framework for regional applications. Securing resources from Alberta Environment will be key for the success of future assessments. The common pollutant inventory is now being prepared under the National Pollutant Release Inventory Program, and it is anticipated that the turnaround time for emissions inventory release will be much quicker. Furthermore, if the tasks of the assessment are confined to the five components specified in the Framework document, the assessment should be conducted at a much faster pace.

## 4.0 RECOMMENDATIONS

To facilitate the next PAI assessment and review of the Management Framework, it is recommended that:

- a. AENV initiate the next assessment and review in 2009 and complete by 2011.
- b. AENV commit adequate manpower and financial resources to complete the assessment and the review in a timely manner.
- c. AENV and Airshed Zones enhance the monitoring network for future model comparison. This could include additional wet deposition (currently 8 precipitation quality stations), additional air quality monitoring stations, and enhanced accessibility to data from stations operated by Airshed Zones. There is also a need to establish operational dry deposition monitoring in Alberta.
- d. AENV broaden the involvement of experts in the science of acid deposition.
- e. AENV consider the 2005-2009 acid deposition research program conducted by CEMA in the oil sands region and if appropriate include its results in the next assessment.
- f. AENV review the RELAD model prior to the start of the next assessment (December 2008).
- g. AENV utilize a multi-stakeholder group to review the approach for assessing sensitivity, and develop a strategy or a long-term program to build a better database for receptor sensitivity to support the approach
- h. As part of the next assessment AENV utilize a multi-stakeholder group to review the treatment of nitrogen in the Framework.

## 5.0 REFERENCES

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